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(54) Mounting arrangement of an ultrasound transducer onto a washing tank.

(57) Mounting arrangement of an ultrasound transducer onto the wall plate of an ultrasound washing tank, wherein the transducer consists of a pair of piezoelectric ceramic disks (2,3), subjected to an electric field variable with an ultrasonic frequency, and of a pair of metallic resonance bodies (4,5) positioned to the sides of said piezoelectric disks (2;3). A first resonance body (5) and two piezoelectric disks (2,3) are mounted externally to the wall plate (1) of the washing tank, while a second resonance body (4) is mounted on the inner side of said wall plate (1), and a bolt (9) axially crosses said bodies (4,5) and disks (2,3) as well as a hole in said wall plate of the washing tank, so as to fix these elements together and onto the wall plate of the tank. A sealing and vibration damping ring gasket (10) is interposed between the inner surface of the wall plate (1) of the washing tank and the surface of the inner resonance body adhering thereto.

The size and shape of the resonance bodies are determined so that a central, nodal, vibration plane substantially coincides with the wall plate of the washing tank.

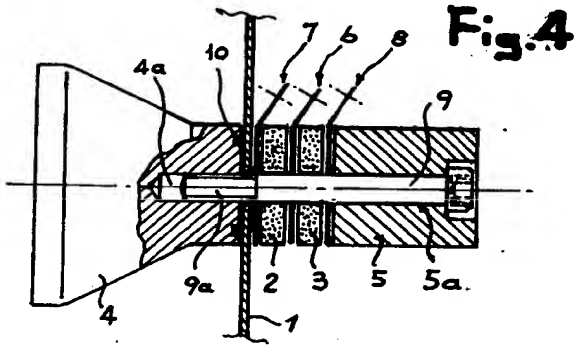

Fig.4

EP 0 479 070 A2

In the technique of washing mechanical pieces, particularly by means of solvents, it is known to carry out a treatment by ultrasounds. The use of ultrasounds allows in fact to wash the pieces more thoroughly and in less time.

The ultrasound transducers used for this purpose fundamentally comprise a pair of piezoelectric ceramic side-by-side disks, and two metallic resonance bodies applied on the opposite sides of said pair of disks. An electrically conductive lamina is interposed between the two disks; an oscillating electric potential, produced by an electronic oscillator, is applied between said lamina and the two metallic resonance bodies - possibly with the interposition of two further conductive laminae between each disk and the metallic resonance body adjacent thereto - said oscillating electric potential being and apt to cause in the disks, due to their piezoelectric nature, a vibration phenomenon which is transmitted to the metallic resonance bodies.

The oscillation frequency is determined by said electronic oscillator circuit at a preset value, included in the ultrasound field, for instance between 20 and 40 KHz, and the dimension and shape of the metal bodies is determined so that they may resonate at that frequency.

To transmit said ultrasonic frequency to the washing liquid, one of the two resonance bodies is normally applied against the wall of the washing tank and is fixed onto said wall by glueing, as shown in figure 1. The wall, which is of thin plate, thus vibrates together with the resonance body of the transducer and transmits the vibration to the washing liquid.

The serious drawback of this system - widely used in these washing plants - is that, in spite of using highly effective adhesives, after a more or less long period of use the transducer may disconnect from the wall of the washing tank, thereby requiring delicate and expensive operations of maintenance and repair.

To overcome this difficulty, it has also been proposed to form a large hole - substantially corresponding to the dimensions of a resonance body - into the wall of the washing tank, and to introduce said body into the washing tank through said hole, fixing it onto its contour. In this case, the fixing is done by welding along the whole line of contact between the edge of the hole and the periphery of the resonance body, as shown in figure 2.

An arrangement very similar to the one hereabove is described in EP-A2-0.341.505, which provides moreover for a support ring being fixedly connected, on one hand, to one of the resonance bodies of the transducer - and precisely, to a frustoconical body projecting into the washing tank and acting as ultrasound emitter - and on the other hand, to the wall of the washing tank. Said support ring is, on one side, formed in one piece with the resonance body or else welded on said body and, on the other side, it is welded onto the wall of the washing tank (see diagram of figure 3).

Nevertheless, also these arrangements are not apt to provide fully satisfactory results, as the welding spots are extremely critical in an environment subject to vibrations, so that, in the long run, yielding points or cracks may form which are practically impossible to repair. The arrangement of EP-A2-0.341.505 has the advantage - in respect of the previous one in which the resonance body is directly welded onto the wall of the washing tank - that the support ring facilitates mounting as well as welding and, at the same time, it forms an element apt to damp the vibrations transmitted from the transducer to the wall; nevertheless, it simply reduces the probabilities of breakage without definitively solving the problem.

For this reason, a modification of said arrangement is often preferred, according to which the transducer is no longer fixed onto the hole of the wall of the washing tank by welding, but by mechanical means, that is, by locking the contour of said hole between a shoulder formed on the resonance body and an opposed locking ring also screwed onto said resonance body. Even this solution has however not been found satisfactory, as it has the additional drawback that the modified shape of the resonance body - allowing to form the shoulder - prevents correct transmission of the ultrasounds.

The object of the present invention is to realize an arrangement for mounting an ultrasound transducer onto the wall plate of a washing tank, which is apt to fully eliminate the above mentioned drawbacks, which is easy to assemble and which is very reliable in the long run. This result is obtained - in a mounting arrangement according to the introductory part of Claim 1 - thanks to the fact that the wall plate of the washing tank is provided with a hole of diameter substantially corresponding to that of the bolt, that this latter crosses in succession, starting from the external part, a first resonance body and the pair of piezoelectric disks mounted on the outer side of said wall plate, then the hole in the wall plate, and finally screws into a threaded dead hole formed in the second resonance body mounted on the inner side of said wall plate, and that a sealing ring gasket is interposed between said second resonance body and the inner surface of said wall plate.

An additional characteristic of the present invention lies moreover in the fact that the shape of the resonance bodies is planned and determined so that the ultrasonic frequency mechanical oscillations - of maximum amplitude in correspondence of the ends of the resonance bodies, particularly in

correspondence of the free surface of the body on the inner side of the washing tank - have a flow such that, as their amplitude reduces towards the innermost transversal sections, they result of no amplitude at all just in correspondence of the section coinciding with the wall plate of the washing tank.

In this way, the piezoelectric disks and the resonance bodies oscillate in contraposition, leaving the central position - namely the position of connection to the wall plate of the washing tank - in still conditions.

Further characteristics and advantages of the arrangement according to the invention will anyhow be more evident from the following detailed description of a preferred embodiment thereof, given by way of example and illustrated on the accompanying drawing, in which:

Figs. 1, 2 and 3 refer to arrangements of known technique, which have already been described; and

Fig. 4 is an axial section view of an ultrasound transducer mounted on a washing tank adopting the arrangement according to the present invention.

As shown, the ultrasound transducer used in the arrangement according to the invention is formed - in a substantially known manner - of a pair of side-by-side piezoelectric ceramic disks 2 and 3, and of a pair of metallic resonance bodies 4 and 5. A lamina 6 of electrically conductive material is interposed between the disks 2 and 3, while two further conductive laminae 7 and 8 are interposed between the disks 2, 3, and the resonance bodies 4, 5, positioned at the respective sides of said disks.

The body 4 has an axial threaded dead hole 4a, and the body 5 has an axial through hole 5a; also the disks 2 and 3 have central holes, equally as the laminae 6, 7 and 8. Said holes are crossed by a bolt 9, the threaded end 9a of which screws into the dead hole 4a of the body 4, and which is apt to lock all these pieces together.

According to the present invention, the lateral wall plate 1 of the washing tank is provided with a hole, which is just sufficient to allow the passage of the bolt 9. To mount the transducer, one therefore proceeds by mounting the resonance body 4 against the inner surface of the wall plate 1, while the disks 2, 3, and the body 5 are mounted externally to said wall plate; the bolt 9 is then introduced through the hole 5a and into the axial holes of the disks 2, 3, as well as into the hole of the wall plate 1, and is then thoroughly screwed into the threaded hole 4a.

Always according to the present invention, a circular groove is formed on the surface of the body 4 mounted against the inner surface of the wall plate 1, said groove housing a sealing gasket 10, of the O-ring type, apt to also perform a vibration damping action.

According to a further characteristic of the present invention, on one hand the excitation of the disks 2 and 3 is carried out in phase contraposition - thanks to a proper adjustment of the feed voltage of the laminae 6, 7, 8 - and on the other hand the size and shape of the resonance bodies 4 and 5 is determined in such a way that the central, nodal, vibration plane coincides with the contact surface between the body 4 and the disk 2.

In this way, while the opposed ends of the bodies 4 and 5 vibrate in synchronism, but in opposite senses (as shown by the dash-and-dot lines in figure 4), the central zone of the transducer and precisely the surfaces of the body 4 and of the disk 2 contacting the wall plate 1 remain substantially still, which means that no vibrations are transmitted to the wall plate 1.

It is thus evident that:

- on one hand due to the fact that the fixing of the ultrasound transducer is guaranteed by the through bolt 9, in cooperation with the sealing gasket 10 which also performs a damping action, with no other locking means and, particularly, with no weld;
- on the other hand due to the fact that the wall plate 1 is practically not subjected to vibrations;

the fixing of the ultrasound transducer on the wall plate 1 is obtained in the most efficient manner and is due to last very long. Furthermore, the mounting is extremely simple and rapid, and the arrangement can also be easily disassembled for replacements or repair.

Claims

1. Mounting arrangement of an ultrasound transducer onto the wall plate of a washing tank, of the type in which the transducer consists of a pair of piezoelectric ceramic disks, subjected to an electric field variable with an ultrasonic frequency, and of a pair of metallic resonance bodies, positioned to the sides of said pair of piezoelectric disks, these elements being fixed together by means of a bolt which axially crosses them, characterized in that said wall plate comprises a hole of diameter substantially corresponding to that of said bolt, in that this latter crosses a first resonance body and the pair of piezoelectric disks mounted externally to said wall plate of the washing tank, then crosses said hole in the wall plate, and finally screws into a threaded dead hole formed in said second resonance body mounted on the inner side of said wall plate, and in

that a sealing and damping ring gasket is interposed between said second resonance body and the inner surface of said wall plate.

2. Mounting arrangement as in claim 1), wherein said second resonance body has a circular groove onto its surface contacting the inner surface of the wall plate of the washing tank, said groove partially housing said sealing and damping gasket.

3. Mounting arrangement as in claim 1), wherein the size and shape of said resonance bodies are determined so that a central, nodal, vibration plane substantially coincides with the contact surface between said second resonance body and the wall plate of the washing tank.

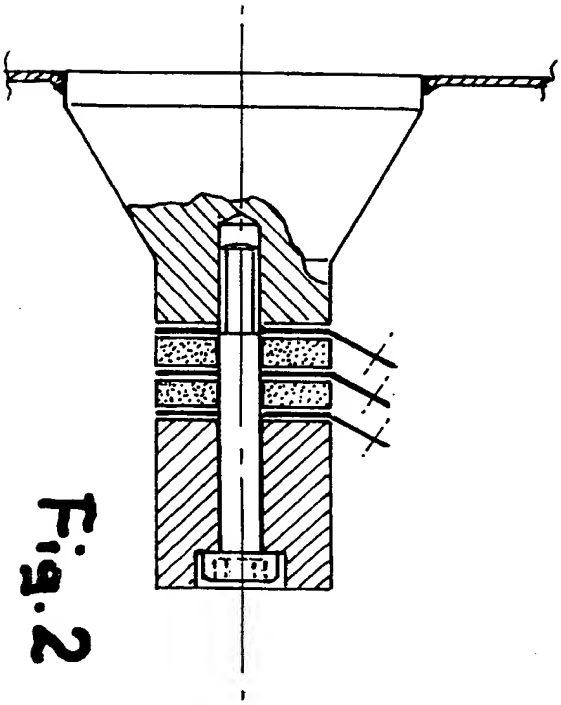

Fig.2

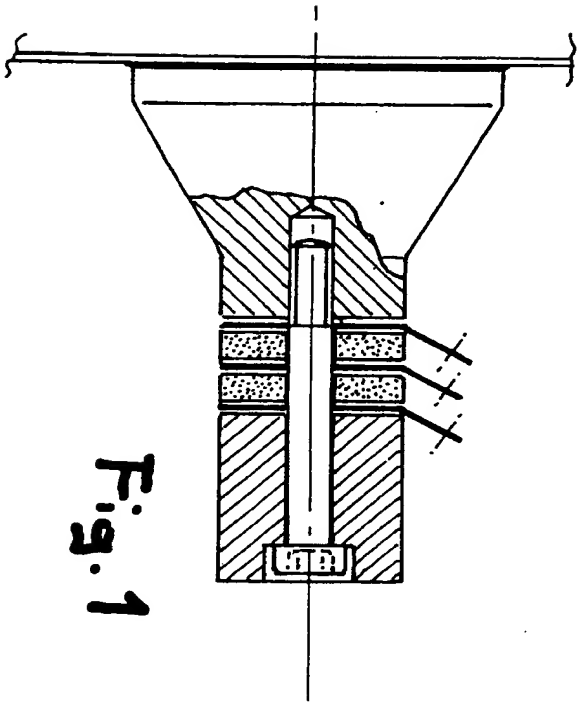

Fig.1

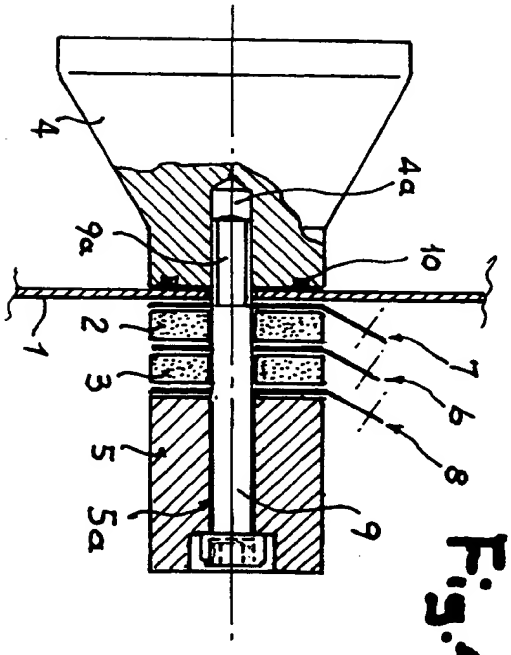

Fig.4

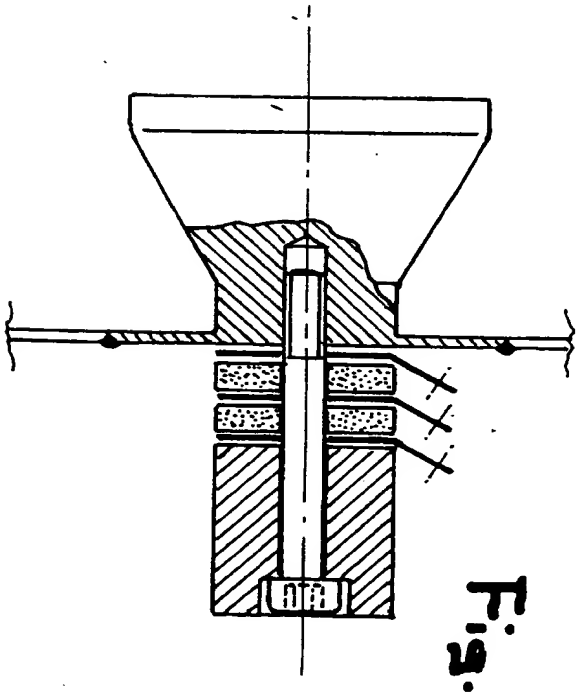

Fig.3

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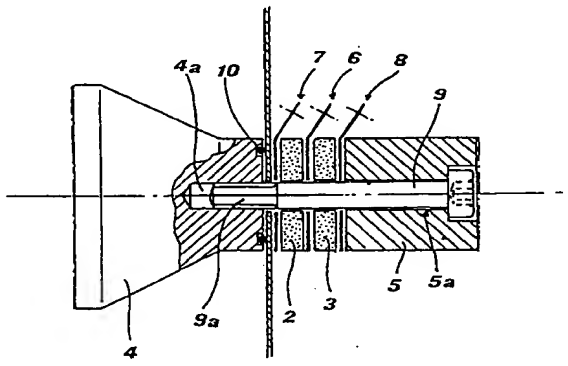

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number

EP 91 11 6058

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 341 505 (M. WALTER ETC) * column 3, line 32 - line 53; figure 1 * *	1-3	B 08 B 3/12 B 06 B 1/06
A	US-A-3 772 538 (M.C. SUPITILOV) * abstract; figure 1 * *	1-3	
A	GB-A-1 044 879 (ULTRASONICS LTD) * page 2, line 55 - line 67; figures * *	1,2	
A	FR-A-1 447 064 (BLACKSTONE CORP.)		
A	US-A-3 524 085 (A.SHOH)		
A	FR-A-1 516 218 (PIEZO-CERAM-ELECTRONIC)		
A	DE-A-2 809 820 (ASAI, KIYOKAZU ET AL)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
B 08 B B 06 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	08 January 92	FRANKS N.M.

CATEGORY OF CITED DOCUMENTS

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